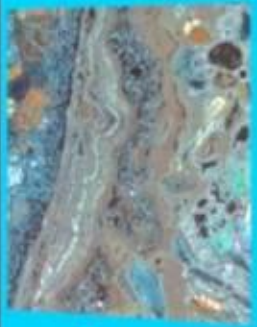
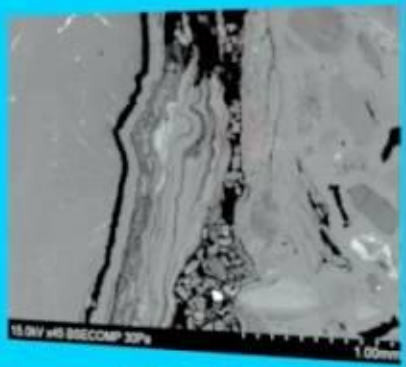
Laminated





Optical

SEM BSE

1
00:00:10,560 --> 00:00:08,520
oh all right as they already said my

2
00:00:12,090 --> 00:00:10,570
name is Gabriella March some of you saw

3
00:00:13,799 --> 00:00:12,100
me last night and this is basically the

4
00:00:16,620 --> 00:00:13,809
same talk only longer and with some

5
00:00:18,980 --> 00:00:16,630
numbers so oh and I don't have the

6
00:00:21,630 --> 00:00:18,990
answer so anyway let's jump right in

7
00:00:23,790 --> 00:00:21,640
thanks to my collaborators I definitely

8
00:00:26,070 --> 00:00:23,800
could not have done this alone and my

9
00:00:27,870 --> 00:00:26,080
sources of funding so here we go so I

10
00:00:29,730 --> 00:00:27,880
studied carbonate cemented conglomerates

11
00:00:31,529 --> 00:00:29,740
this is what they look like it looks a

12
00:00:32,760 --> 00:00:31,539
lot like concrete it's pretty boring

13
00:00:33,960 --> 00:00:32,770

it's hard to get away from because I

14
00:00:37,470 --> 00:00:33,970
always see concrete so I'm always

15
00:00:40,049 --> 00:00:37,480
thinking about my rocks and what I've

16
00:00:41,700 --> 00:00:40,059
hypothesized is that if you can't find

17
00:00:42,990 --> 00:00:41,710
organic material or living organisms

18
00:00:44,939 --> 00:00:43,000
which is possible that we may not be

19
00:00:48,330 --> 00:00:44,949
able to find most immediately on Mars

20
00:00:49,560 --> 00:00:48,340
maybe you can use isotopes and the

21
00:00:52,380 --> 00:00:49,570
mineralogy sort of a detailed

22
00:00:54,840 --> 00:00:52,390
investigation to prove the or service

23
00:00:56,729 --> 00:00:54,850
evidence that life existed so it'd be

24
00:00:59,130 --> 00:00:56,739
started the study we thought we'd find

25
00:01:01,229 --> 00:00:59,140
negative carbon isotopes we thought we'd

26
00:01:03,150 --> 00:01:01,239
find dramatic variability in the

27
00:01:05,100 --> 00:01:03,160
isotopes and in the mineralogy on a fine

28
00:01:07,620 --> 00:01:05,110
scale and then mineralogical

29
00:01:09,420 --> 00:01:07,630
heterogeneity so we'll get into that all

30
00:01:10,980 --> 00:01:09,430
right so I investigated rocks from two

31
00:01:13,160 --> 00:01:10,990
different creaks adobe creek and del

32
00:01:16,170 --> 00:01:13,170
Puerto Creek this is what they look like

33
00:01:17,400 --> 00:01:16,180
they're pretty low flow in the

34
00:01:18,990 --> 00:01:17,410
wintertime which is when I went and

35
00:01:20,280 --> 00:01:19,000
collected rocks it looks like somebody

36
00:01:21,960 --> 00:01:20,290
dumped a whole bunch of concrete into

37
00:01:24,390 --> 00:01:21,970
the rivers and I want to point out that

38
00:01:28,500 --> 00:01:24,400

there is ooh that there are microbial

39
00:01:32,100 --> 00:01:28,510
mats all over the place so a note for

40
00:01:34,200 --> 00:01:32,110
you biologists out there so this is the

41
00:01:36,930 --> 00:01:34,210
i found these creeks run through the

42
00:01:39,090 --> 00:01:36,940
dell printer over your light adobe creek

43
00:01:41,480 --> 00:01:39,100
runs this way into del puerto rican whr

44
00:01:43,680 --> 00:01:41,490
creek runs runs down this is downstream

45
00:01:44,820 --> 00:01:43,690
and so those are my sampling sites

46
00:01:47,130 --> 00:01:44,830
they're actually pretty close together

47
00:01:51,210 --> 00:01:47,140
but could come from very distinct

48
00:01:53,760 --> 00:01:51,220
watersheds and this is where the del

49
00:01:56,370 --> 00:01:53,770
Puerto feel is located so it's in

50
00:01:58,620 --> 00:01:56,380
California it's part of the California

51
00:02:00,180 --> 00:01:58,630
coast range Oh feel light system so

52
00:02:03,150 --> 00:02:00,190
there's lots of ophiolites up and down

53
00:02:06,150 --> 00:02:03,160
the coast and it's pretty close to San

54
00:02:08,339 --> 00:02:06,160
Francisco and the closest big city is

55
00:02:12,600 --> 00:02:08,349
Livermore so that's where we stay in

56
00:02:14,819 --> 00:02:12,610
hotels okay so it's a no fee alight and

57
00:02:17,369 --> 00:02:14,829
I use that word and some of you may not

58
00:02:19,640 --> 00:02:17,379
know what that means so we use

59
00:02:20,869 --> 00:02:19,650
ophiolites as Mars analog

60
00:02:24,649 --> 00:02:20,879
I don't think this has been mentioned

61
00:02:26,330 --> 00:02:24,659
before but basically Mars's crust which

62
00:02:28,940 --> 00:02:26,340
is kind of what I'm investigating it's

63
00:02:32,179 --> 00:02:28,950

an analog for Mars Mars Chris never got

64
00:02:34,580 --> 00:02:32,189
differentiated so it's mostly may thick

65
00:02:36,559 --> 00:02:34,590
and ultramafic rocks which is the same

66
00:02:39,140 --> 00:02:36,569
thing we find on earth in the ocean

67
00:02:40,610 --> 00:02:39,150
crust so we have may fick and ultramafic

68
00:02:43,809 --> 00:02:40,620
rocks in the ocean crust we have

69
00:02:48,530 --> 00:02:43,819
continental crust which is high in

70
00:02:50,509 --> 00:02:48,540
aluminum silicon things like that so if

71
00:02:52,099 --> 00:02:50,519
we want a study on Mars analog we really

72
00:02:55,039 --> 00:02:52,109
need that ocean crust which obviously is

73
00:02:59,149 --> 00:02:55,049
underwater which is an issue but luckily

74
00:03:00,589 --> 00:02:59,159
at subduction zones when the plate the

75
00:03:02,509 --> 00:03:00,599
ocean krutz gets abducted under the

76
00:03:04,460 --> 00:03:02,519
continental crust sometimes a chunk of

77
00:03:06,140 --> 00:03:04,470
that ocean crust and even sometimes a

78
00:03:08,899 --> 00:03:06,150
bit of the mantle gets shoved up onto

79
00:03:12,199 --> 00:03:08,909
the land which is what we call an Ohio

80
00:03:13,399 --> 00:03:12,209
light sweet and those may thicken

81
00:03:15,860 --> 00:03:13,409
ultramafic rocks are sort of a

82
00:03:17,119 --> 00:03:15,870
compositional analog for Mars so there's

83
00:03:19,910 --> 00:03:17,129
a lot of interest in the chemistry of

84
00:03:21,349 --> 00:03:19,920
the water that runs through there and as

85
00:03:23,900 --> 00:03:21,359
an analog for Mars so it's pretty

86
00:03:26,140 --> 00:03:23,910
exciting so just to give you some

87
00:03:28,039 --> 00:03:26,150
context as to why you should even care

88
00:03:30,740 --> 00:03:28,049

carbonates are definitely on Mars

89
00:03:33,199 --> 00:03:30,750
they've identified those and there are

90
00:03:36,080 --> 00:03:33,209
definitely conglomerates on Mars those

91
00:03:39,470 --> 00:03:36,090
are my rocks right here these are Mars

92
00:03:44,089 --> 00:03:39,480
rocks just saying they look a little

93
00:03:47,149 --> 00:03:44,099
like okay so dolomite the carbonate that

94
00:03:48,649 --> 00:03:47,159
cement this conglomerate together one of

95
00:03:50,180 --> 00:03:48,659
them one of the carbonates in there is

96
00:03:51,170 --> 00:03:50,190
called dolomite and for those of you

97
00:03:56,920 --> 00:03:51,180
that don't know what that is it's

98
00:04:02,559 --> 00:03:59,569
dolomite been a problem for geologists

99
00:04:04,580 --> 00:04:02,569
because forever we could not get it to

100
00:04:08,449 --> 00:04:04,590
precipitate out of solution in the lab

101
00:04:10,159 --> 00:04:08,459
and poor dr. land did this for 32 years

102
00:04:12,830 --> 00:04:10,169
in perfect conditions and it never

103
00:04:15,830 --> 00:04:12,840
happened but then we found out later

104
00:04:17,750 --> 00:04:15,840
that we add microbes to the mix and some

105
00:04:21,800 --> 00:04:17,760
sort of microbial mediation goes on it's

106
00:04:24,560 --> 00:04:21,810
not like a coral or a shell that that a

107
00:04:27,769 --> 00:04:24,570
a clam is making its it's some sort of

108
00:04:29,209 --> 00:04:27,779
indirect influence and there's a lot of

109
00:04:31,279 --> 00:04:29,219
theories as to how that happens it might

110
00:04:32,670 --> 00:04:31,289
just be sort of cellular material in the

111
00:04:34,499 --> 00:04:32,680
area they might we're not

112
00:04:36,629 --> 00:04:34,509
sure what they do but we say that they

113
00:04:38,430 --> 00:04:36,639

might they mediate the formation of the

114
00:04:40,050 --> 00:04:38,440
dolomites and they are necessary in

115
00:04:41,670 --> 00:04:40,060
order for dolomite to form in these

116
00:04:45,779 --> 00:04:41,680
types of environments at low

117
00:04:47,999 --> 00:04:45,789
temperatures all right so I'm going to

118
00:04:50,270 --> 00:04:48,009
talk a lot about magnesium content in

119
00:04:53,700 --> 00:04:50,280
the data and this is important because

120
00:04:55,980 --> 00:04:53,710
calcite is just pure calcium with

121
00:04:58,710 --> 00:04:55,990
carbonate whereas dolomite is calcium

122
00:05:01,020 --> 00:04:58,720
and magnesium with carbonate and it's a

123
00:05:03,659 --> 00:05:01,030
solid solution between these two it's

124
00:05:05,460 --> 00:05:03,669
very rarely perfect one or the other so

125
00:05:06,990 --> 00:05:05,470
you'll see high magnesium calcite switch

126
00:05:08,999 --> 00:05:07,000
means you have less than one hundred

127
00:05:12,540 --> 00:05:09,009
percent of calcite and then usually you

128
00:05:14,070 --> 00:05:12,550
I actually found no perfect dolomite in

129
00:05:15,629 --> 00:05:14,080
any of my samples it was always

130
00:05:17,430 --> 00:05:15,639
something that was slightly less than

131
00:05:19,740 --> 00:05:17,440
fifty percent but something mineralogist

132
00:05:21,810 --> 00:05:19,750
would still classify as dolomite so here

133
00:05:24,120 --> 00:05:21,820
you have a layer of calcium lale layer

134
00:05:25,499 --> 00:05:24,130
of carbonate and on and on in the

135
00:05:27,860 --> 00:05:25,509
dolomites you have a layer of calcium

136
00:05:31,350 --> 00:05:27,870
carbonate than a layer of magnesium

137
00:05:34,379 --> 00:05:31,360
carbonate so it kind of goes back and

138
00:05:36,360 --> 00:05:34,389

forth which is a nice orderly way but

139
00:05:39,750 --> 00:05:36,370
that never happens in real life it's

140
00:05:41,219 --> 00:05:39,760
just theoretical so magnesium content in

141
00:05:44,730 --> 00:05:41,229
the carbon and cement so here are my

142
00:05:45,960 --> 00:05:44,740
actual rocks in the triangles you have

143
00:05:48,149 --> 00:05:45,970
adobe creek which i'll use throughout

144
00:05:50,430 --> 00:05:48,159
the rest of the presentation in squares

145
00:05:52,680 --> 00:05:50,440
we have del perrito creek and you'll see

146
00:05:54,060 --> 00:05:52,690
that we have magnesium content from 0%

147
00:05:57,029 --> 00:05:54,070
all the way up to fifty percent which

148
00:05:58,469 --> 00:05:57,039
would be perfect ideal dolomite and then

149
00:06:02,310 --> 00:05:58,479
one hundred percent calcium all the way

150
00:06:04,110 --> 00:06:02,320
down to fifty percent so adobe creek end

151
00:06:05,850 --> 00:06:04,120
up where two creeks are there this is

152
00:06:07,170 --> 00:06:05,860
where dolomite would plot what we'd call

153
00:06:08,580 --> 00:06:07,180
dolomite about thirty-six percent

154
00:06:10,409 --> 00:06:08,590
magnesium all the way up to fifty

155
00:06:11,700 --> 00:06:10,419
percent magnesium in the crystal

156
00:06:14,510 --> 00:06:11,710
structure and you'll see a lot of those

157
00:06:16,649 --> 00:06:14,520
points fall into the dolomite range oh

158
00:06:19,649 --> 00:06:16,659
but then you also have a lot of in high

159
00:06:21,240 --> 00:06:19,659
magnesium calcite and obviously there's

160
00:06:22,649 --> 00:06:21,250
a lot more of that in adobe creek than

161
00:06:24,270 --> 00:06:22,659
we see in del puerto creek but that

162
00:06:26,700 --> 00:06:24,280
could be sampling bias let's be

163
00:06:28,499 --> 00:06:26,710

realistic and then there's also low

164
00:06:30,270 --> 00:06:28,509
magnesium calcite i only have one point

165
00:06:31,950 --> 00:06:30,280
represented in that and it may actually

166
00:06:34,070 --> 00:06:31,960
be in a ragga night for those of you

167
00:06:36,480 --> 00:06:34,080
meteorologists or challenges out there

168
00:06:38,670 --> 00:06:36,490
so the next thing i want to talk about

169
00:06:40,140 --> 00:06:38,680
quickly with dolomite is that not only

170
00:06:42,149 --> 00:06:40,150
is there variable magnesium content

171
00:06:44,760 --> 00:06:42,159
there's also the concept of order and

172
00:06:46,260 --> 00:06:44,770
disorder so this again is the ideal

173
00:06:48,090 --> 00:06:46,270
dolomite structure right so you

174
00:06:50,060 --> 00:06:48,100
a layer of calcium layer of magnesium

175
00:06:53,100 --> 00:06:50,070
and on and on and on so an ordered

176
00:06:57,120 --> 00:06:53,110
dolomite can have variable magnesium

177
00:06:58,860 --> 00:06:57,130
contents but those magnesium elements

178
00:07:00,690 --> 00:06:58,870
will stay confined to those orange

179
00:07:02,280 --> 00:07:00,700
magnesium layers so you could find

180
00:07:03,330 --> 00:07:02,290
magnesium here here and here but you

181
00:07:05,160 --> 00:07:03,340
also might have some calcium

182
00:07:07,080 --> 00:07:05,170
incorporated in there so that's what we

183
00:07:08,790 --> 00:07:07,090
call an order dolomite a disordered

184
00:07:09,960 --> 00:07:08,800
dolomite is something that you

185
00:07:11,760 --> 00:07:09,970
definitely have magnesium those

186
00:07:14,580 --> 00:07:11,770
magnesium layers but you can also have

187
00:07:16,320 --> 00:07:14,590
magnesium in the calcium layers so it's

188
00:07:18,180 --> 00:07:16,330

a lot more mixed up which is why we call

189
00:07:22,080 --> 00:07:18,190
it disordered so you could see magnesium

190
00:07:23,940 --> 00:07:22,090
at any one of those layers so here's an

191
00:07:24,930 --> 00:07:23,950
x-ray diffraction pattern don't get too

192
00:07:26,550 --> 00:07:24,940
nervous if you don't know what this

193
00:07:28,020 --> 00:07:26,560
looks like I'm going to be a pretty

194
00:07:30,150 --> 00:07:28,030
simple example so this is an actual

195
00:07:31,680 --> 00:07:30,160
pattern from one of my rocks that's

196
00:07:33,780 --> 00:07:31,690
pretty representative of the hole and

197
00:07:35,370 --> 00:07:33,790
I'm going to overlay an ideal dolomite

198
00:07:37,560 --> 00:07:35,380
pattern right but this is not ideal

199
00:07:39,810 --> 00:07:37,570
dolomite this is this is actually a

200
00:07:42,060 --> 00:07:39,820
dolomite with variable magnesium content

201
00:07:43,710 --> 00:07:42,070
that's actually disordered so the way we

202
00:07:45,210 --> 00:07:43,720
know that is you'll notice that this

203
00:07:46,590 --> 00:07:45,220
peak right here which I'm pointing to in

204
00:07:48,500 --> 00:07:46,600
with an arrow because this is the one we

205
00:07:51,210 --> 00:07:48,510
like to use because it's nice and strong

206
00:07:52,860 --> 00:07:51,220
it's very wide here and that's an

207
00:07:54,510 --> 00:07:52,870
indication that we're getting lots of

208
00:07:56,670 --> 00:07:54,520
different magnesium contents in a very

209
00:07:58,590 --> 00:07:56,680
small amount of material that we are

210
00:08:00,690 --> 00:07:58,600
measuring so there's a lot of

211
00:08:02,940 --> 00:08:00,700
heterogeneity and then also you'll see

212
00:08:05,160 --> 00:08:02,950
that this peak is very offset from where

213
00:08:06,780 --> 00:08:05,170

the ideal peak is right so here's the

214
00:08:09,240 --> 00:08:06,790
peak I've and then there's the overlay

215
00:08:12,030 --> 00:08:09,250
and that offset is an indication of

216
00:08:13,860 --> 00:08:12,040
disorder so we know that just based on

217
00:08:15,570 --> 00:08:13,870
the xrd patterns that there's lots of

218
00:08:17,370 --> 00:08:15,580
different types of magnesium contents

219
00:08:19,650 --> 00:08:17,380
and also disorder in the structure and

220
00:08:21,030 --> 00:08:19,660
there is tem data to back this up if

221
00:08:23,570 --> 00:08:21,040
you're interested to look at it with me

222
00:08:26,190 --> 00:08:23,580
but I didn't have time to show it today

223
00:08:27,930 --> 00:08:26,200
alright so just to review where we are

224
00:08:29,160 --> 00:08:27,940
the so far so these are streambed

225
00:08:31,020 --> 00:08:29,170
conglomerates that means they're low

226
00:08:33,270 --> 00:08:31,030
temperature so they're formed at Earth's

227
00:08:34,740 --> 00:08:33,280
surface temperatures it's disordered

228
00:08:36,210 --> 00:08:34,750
which we're pretty sure is modern

229
00:08:37,890 --> 00:08:36,220
because if you give it enough time it

230
00:08:40,680 --> 00:08:37,900
will eventually order itself so we know

231
00:08:42,090 --> 00:08:40,690
it's a modern dolomite and so what we

232
00:08:44,490 --> 00:08:42,100
need to investigate nests at the edge

233
00:08:45,720 --> 00:08:44,500
the microbial involvement and so how I'm

234
00:08:47,460 --> 00:08:45,730
going to do that as carbon and oxygen

235
00:08:50,670 --> 00:08:47,470
isotopes and I'm only going to show

236
00:08:52,680 --> 00:08:50,680
carbon today so here's an adobe creek

237
00:08:55,440 --> 00:08:52,690
rock and a del puerto Creek rock finally

238
00:08:56,910 --> 00:08:55,450

we see some rocks you'll notice that del

239
00:08:59,550 --> 00:08:56,920
cuadro creek looks pretty distinct it's

240
00:09:02,610 --> 00:08:59,560
got a lot more it's not more classed

241
00:09:04,440 --> 00:09:02,620
heavy and so here are the different

242
00:09:06,150 --> 00:09:04,450
textures of carbon it you find within

243
00:09:09,420 --> 00:09:06,160
these so you'll see these laminated on

244
00:09:11,130 --> 00:09:09,430
these layers on the clasts which are

245
00:09:12,780 --> 00:09:11,140
pretty beautiful there's vein fillings

246
00:09:15,030 --> 00:09:12,790
that you'll see there's this fine

247
00:09:17,220 --> 00:09:15,040
grained sort of grayish material that we

248
00:09:19,010 --> 00:09:17,230
can't you can't see any sort of textures

249
00:09:21,750 --> 00:09:19,020
in there and then surface laminations

250
00:09:22,560 --> 00:09:21,760
which are nice and thick but I'm not

251
00:09:25,290 --> 00:09:22,570
going to talk about the surface

252
00:09:28,140 --> 00:09:25,300
laminations today so here's what

253
00:09:29,460 --> 00:09:28,150
laminated looks like in opted for an

254
00:09:32,340 --> 00:09:29,470
optical microscope and also in

255
00:09:35,370 --> 00:09:32,350
backscatter electron on the SEM I like

256
00:09:38,610 --> 00:09:35,380
to point out that this is pretty narrow

257
00:09:40,140 --> 00:09:38,620
which is why we had to use a lot of kind

258
00:09:42,540 --> 00:09:40,150
of Institute techniques in order to

259
00:09:44,070 --> 00:09:42,550
investigate this just crushing it up is

260
00:09:46,800 --> 00:09:44,080
not really good enough to understand it

261
00:09:49,019 --> 00:09:46,810
so anyway this here are the carbonate

262
00:09:51,000 --> 00:09:49,029
layers and there's a lot of clay mixed

263
00:09:54,180 --> 00:09:51,010

in there so again this isn't backscatter

264
00:09:55,380 --> 00:09:54,190
right here would be a clay layer and we

265
00:09:56,610 --> 00:09:55,390
can talk about clays for those of you

266
00:09:59,040 --> 00:09:56,620
that interest in clays if you want to

267
00:10:01,680 --> 00:09:59,050
talk with me later here's the vein

268
00:10:04,260 --> 00:10:01,690
filling looks very similar and like to

269
00:10:07,110 --> 00:10:04,270
point out this is 500 microns which is

270
00:10:08,640 --> 00:10:07,120
about the length of that here's what

271
00:10:10,350 --> 00:10:08,650
fine grain material looks like and

272
00:10:12,030 --> 00:10:10,360
you'll see it's a lot messier clay is

273
00:10:15,480 --> 00:10:12,040
kind of mixed in and not in any sort of

274
00:10:17,160 --> 00:10:15,490
wrap up ordered way and then you get

275
00:10:18,420 --> 00:10:17,170
this sort of smooth looking appearance

276
00:10:21,990 --> 00:10:18,430
in the fine grid material in the

277
00:10:24,990 --> 00:10:22,000
backscatter so why do I bother with

278
00:10:28,290 --> 00:10:25,000
carbon isotopes so there's three

279
00:10:31,620 --> 00:10:28,300
isotopes of carbon 12 13 14 12 is the

280
00:10:33,780 --> 00:10:31,630
most common 13 is a stable I stable

281
00:10:37,290 --> 00:10:33,790
isotope and 14 is radioactive so we're

282
00:10:40,620 --> 00:10:37,300
going to ignore 14 for today carbon-12

283
00:10:42,840 --> 00:10:40,630
and carbon-14 we we measure the ratio

284
00:10:46,110 --> 00:10:42,850
between them biological processes

285
00:10:47,640 --> 00:10:46,120
preferentially use carbon-12 and so if

286
00:10:49,410 --> 00:10:47,650
you have more carbon 12 what you'll see

287
00:10:51,480 --> 00:10:49,420
in the ratio is you'll see more negative

288
00:10:54,030 --> 00:10:51,490

as that gets more negative means more

289
00:10:56,640 --> 00:10:54,040
biology lower carbon 12 is more positive

290
00:10:59,760 --> 00:10:56,650
so here's an example of how organisms

291
00:11:01,140 --> 00:10:59,770
can drive carbon isotope ratios and as

292
00:11:04,110 --> 00:11:01,150
it drives more negative you'll see all

293
00:11:07,740 --> 00:11:04,120
these different microbes and that can

294
00:11:09,780 --> 00:11:07,750
drive the ratios more negative so I did

295
00:11:11,730 --> 00:11:09,790
Sims analysis which secondary ion mass

296
00:11:12,850 --> 00:11:11,740
spectrometer which we can do isotope

297
00:11:14,830 --> 00:11:12,860
ratios with

298
00:11:16,300 --> 00:11:14,840
10 micron spot sizes which is super cool

299
00:11:18,190 --> 00:11:16,310
we can talk about that later if you want

300
00:11:21,400 --> 00:11:18,200
here's where the spots are just in case

301
00:11:23,680 --> 00:11:21,410
you have a hard time seeing them and

302
00:11:25,540 --> 00:11:23,690
here are the results so triangles are

303
00:11:27,130 --> 00:11:25,550
adobe creek squares or del cuarto creek

304
00:11:29,500 --> 00:11:27,140
and what i want to point out first of

305
00:11:33,820 --> 00:11:29,510
all is negative 8 to negative 13 that's

306
00:11:35,410 --> 00:11:33,830
a pretty small range here i'm going to

307
00:11:37,450 --> 00:11:35,420
split it out by rock and by creek to

308
00:11:38,680 --> 00:11:37,460
kind of see if we can see anything so

309
00:11:40,900 --> 00:11:38,690
there's the two different rocks from

310
00:11:42,640 --> 00:11:40,910
adobe creek i investigated that's where

311
00:11:45,310 --> 00:11:42,650
dolomite calcite and low magnesian

312
00:11:46,420 --> 00:11:45,320
calcite plot you'll see the first thing

313
00:11:50,380 --> 00:11:46,430

i noticed here was i thought that

314
00:11:51,550 --> 00:11:50,390
dolomite might have lower isotope ratios

315
00:11:53,080 --> 00:11:51,560
you know because more microbial

316
00:11:54,940 --> 00:11:53,090
involvement but there actually is no

317
00:11:57,790 --> 00:11:54,950
correlation there because the high

318
00:11:59,350 --> 00:11:57,800
magnesium Cal sets just as lo del Puerto

319
00:12:03,520 --> 00:11:59,360
terrific you split it up by rock you see

320
00:12:06,310 --> 00:12:03,530
no correlations again there's the more

321
00:12:08,020 --> 00:12:06,320
dolomite than you see in adobe creek and

322
00:12:09,840 --> 00:12:08,030
then they split it out by textures so

323
00:12:13,240 --> 00:12:09,850
laminated fine grained vein filling

324
00:12:16,120 --> 00:12:13,250
nothing pops out of the data there's all

325
00:12:17,440 --> 00:12:16,130
of it together and so i just spent all

326
00:12:19,840 --> 00:12:17,450
my time you know i went through all this

327
00:12:22,270 --> 00:12:19,850
and we didn't we didn't find anything

328
00:12:23,680 --> 00:12:22,280
interesting in the in the carbon isotope

329
00:12:25,480 --> 00:12:23,690
data but that doesn't mean that this

330
00:12:27,340 --> 00:12:25,490
isn't interesting at all and what we see

331
00:12:30,790 --> 00:12:27,350
is this negative eight to negative 13

332
00:12:31,630 --> 00:12:30,800
actually matters so that's more negative

333
00:12:34,420 --> 00:12:31,640
than you're going to find in that

334
00:12:36,010 --> 00:12:34,430
completely inorganic material but it's

335
00:12:37,060 --> 00:12:36,020
not as negative was we wanted to see we

336
00:12:39,370 --> 00:12:37,070
thought there would be some sort of

337
00:12:40,750 --> 00:12:39,380
interaction with microbes on a small

338
00:12:43,150 --> 00:12:40,760

scale which you get super negative

339
00:12:45,280 --> 00:12:43,160
numbers which we didn't see which was

340
00:12:47,560 --> 00:12:45,290
kind of a bummer but it still indicates

341
00:12:49,890 --> 00:12:47,570
Biogen icity and just to give you a

342
00:12:53,740 --> 00:12:49,900
sense of how homogenous this material is

343
00:12:55,420 --> 00:12:53,750
that pink circles are where my samples

344
00:12:57,370 --> 00:12:55,430
plot whereas the other samples are

345
00:13:00,070 --> 00:12:57,380
fields of different carbonates in ohio

346
00:13:02,950 --> 00:13:00,080
light sweets and other systems not

347
00:13:06,160 --> 00:13:02,960
always dolomite but it's super super

348
00:13:10,540 --> 00:13:06,170
tight data field which is interesting

349
00:13:12,310 --> 00:13:10,550
unto itself and so we thought we'd find

350
00:13:13,720 --> 00:13:12,320
negative carbon isotopes we did but they

351
00:13:15,850 --> 00:13:13,730
weren't as negative as we wanted and we

352
00:13:17,080 --> 00:13:15,860
didn't see that dramatic variability but

353
00:13:18,460 --> 00:13:17,090
we did find the mineralogical

354
00:13:21,700 --> 00:13:18,470
heterogeneity which is pretty

355
00:13:25,090 --> 00:13:21,710
interesting unto itself so there is an

356
00:13:26,470 --> 00:13:25,100
evidence of life in these rocks but it's

357
00:13:36,970 --> 00:13:26,480
not a slam dunk

358
00:13:54,009 --> 00:13:36,980
so thanks do we have any questions for

359
00:13:59,509 --> 00:13:57,350
do you have any idea at all what the

360
00:14:01,670 --> 00:13:59,519
microbes how the microbes interacting

361
00:14:03,860 --> 00:14:01,680
with the carbonate and forming a bio

362
00:14:05,360 --> 00:14:03,870
signature or you just know something is

363
00:14:07,100 --> 00:14:05,370

going on we know that something is going

364
00:14:08,660 --> 00:14:07,110
on it's hard to say and a lot of people

365
00:14:10,790 --> 00:14:08,670
have different theories right now it's

366
00:14:14,180 --> 00:14:10,800
kind of the the debate in the dolomites

367
00:14:16,610 --> 00:14:14,190
literature at the moment so sometimes I

368
00:14:18,500 --> 00:14:16,620
think it might just be the sort of

369
00:14:19,699 --> 00:14:18,510
extracellular material that goes along

370
00:14:21,560 --> 00:14:19,709
with the microbes that might be

371
00:14:23,750 --> 00:14:21,570
influencing it but basically you want to

372
00:14:25,310 --> 00:14:23,760
separate the magnesium from the water

373
00:14:27,380 --> 00:14:25,320
because magnesium and water love each

374
00:14:28,639 --> 00:14:27,390
other and magnesium can't get into the

375
00:14:30,170 --> 00:14:28,649
crystal structure so anything that

376
00:14:31,940 --> 00:14:30,180
dissociates that magnesium from the

377
00:14:33,199 --> 00:14:31,950
water and allows it get into the crystal

378
00:14:41,540 --> 00:14:33,209
structure is what's happening

379
00:14:43,970 --> 00:14:41,550
essentially you said you're negative

380
00:14:45,519 --> 00:14:43,980
carbon isotope values were not a slam

381
00:14:47,960 --> 00:14:45,529
dunk I was wondering if you could

382
00:14:50,810 --> 00:14:47,970
comment on what the minimum negative

383
00:14:52,460 --> 00:14:50,820
slam dunk value would be and then if you

384
00:14:58,069 --> 00:14:52,470
could just give a one-sentence summary

385
00:15:00,199 --> 00:14:58,079
of your oxygen isotope result okay so we

386
00:15:01,639 --> 00:15:00,209
were hoping to see negative 15 and below

387
00:15:06,829 --> 00:15:01,649
that was kind of the number i had in my

388
00:15:08,780 --> 00:15:06,839

head negative 10 could be happening with

389
00:15:10,819 --> 00:15:08,790
nothing to do with the microbes so net

390
00:15:12,280 --> 00:15:10,829
rivers naturally have a negative isotope

391
00:15:15,079 --> 00:15:12,290
value because you're getting this input

392
00:15:17,300 --> 00:15:15,089
from the surrounding watershed which all

393
00:15:18,530 --> 00:15:17,310
these plants and animals and microbes in

394
00:15:19,910 --> 00:15:18,540
the soil and so you're getting that

395
00:15:22,280 --> 00:15:19,920
negative carbonized to have input into

396
00:15:23,690 --> 00:15:22,290
the water itself so something that

397
00:15:24,949 --> 00:15:23,700
negative doesn't necessarily have

398
00:15:26,540 --> 00:15:24,959
anything to do with the microbes in the

399
00:15:29,180 --> 00:15:26,550
lake it could have something to do with

400
00:15:30,650 --> 00:15:29,190
the organics and the in the watershed so

401
00:15:32,569 --> 00:15:30,660
I really wanted to see things negative

402
00:15:33,740 --> 00:15:32,579
15 negative 20 which is what we thought

403
00:15:35,630 --> 00:15:33,750
we'd find we thought we were seeing

404
00:15:37,069 --> 00:15:35,640
averages in the bulk scale but it turns

405
00:15:38,900 --> 00:15:37,079
out that was actually what is on the

406
00:15:41,720 --> 00:15:38,910
fine scale as well and then with the

407
00:15:43,250 --> 00:15:41,730
oxygen isotopes I just got the data last

408
00:15:45,050 --> 00:15:43,260
week so we're still working on it but

409
00:15:46,400 --> 00:15:45,060
some of the preliminary stuff we saw was

410
00:15:49,220 --> 00:15:46,410
there is separation between the

411
00:15:50,780 --> 00:15:49,230
different textures so fine grained and

412
00:15:52,370 --> 00:15:50,790
laminated material plots in completely

413
00:15:54,050 --> 00:15:52,380

different areas so these are probably

414
00:15:55,550 --> 00:15:54,060
different generations of growth either

415
00:15:57,620 --> 00:15:55,560
they grow in different seasons or a

416
00:15:58,550 --> 00:15:57,630
different times of the day or there's

417
00:16:00,110 --> 00:15:58,560
different like that we don't know

418
00:16:02,480 --> 00:16:00,120
exactly what but there's definitely some

419
00:16:04,069 --> 00:16:02,490
clumping of the oxygen isotopes which I